Conscious Culture

Why are we trying to solve our ecological problems with all the wrong answers? Because the right answers challenge our lifestyle. It is absolutely impossible to support the American lifestyle in a sustainable fashion with any energy source. The most destructive aspect of biofuels, if approached from the supply-side, is that the biofuels movement creates and perpetuates the myth that our lifestyle can continue if only we find the right fuel -- biodiesel, hydrogen, etc.

Single family housing, as well as individual automobiles, are simply unsustainable, regardless of our energy source. So what then are the solutions? Live close enough to work so you don't have to drive. Live cooperatively. Refuse to own a car. For many people, that may sound absurd, but that is precisely why the entire discussion about biofuels is misguided --because the real solutions are socially and culturally problematic.

The real solutions are there, and have been for a while. Even very simple technologies like solar water heating are very hard to pay for in single family housing because the capital cost is high relative the very low intensity of use in a single family home. With cooperative living, not only is the consumption of many resources divided by the number of people sharing that resource, but the higher capital costs of alternative energy systems becomes a lot more reasonable because they are being used more intensively. If you are looking at housing and energy options, insulate and seal up, then worry about supply.

Most importantly, build a culture around you, in cooperation with the people around you, that supports a lifestyle that is not based on single family housing and individual automobiles.[1] This is the key point, because humans are very social animals, and need the support of our fellow humans. We become our social environment over time. True sustainability comes from consciously creating a social environment that supports a sustainable lifestyle. Convince other people to join you in this great task. And after we have have put the movement well underway to collectively choose how we live, then we can choose the most benign sources of energy to support us. That is a real answer. Turning the beast of industrialism with its voracious appetite away from fossil fuel and into our forests and fields is not an answer.

1 Zeigler, Alexis, Conscious Cultural Evolution, Understanding Our Past, Choosing Our Future, Ecodem Press, Charlottesville, 1996, aslo at www.conev.org

Biodiesel

And Other Biofuels in Ecological Perspective

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Biodiesel is the fastest growing alternative fuel in the U.S. For the proponents of biodiesel and other biofuels, they hold out the promises of an age of clean and renewable fuel. If present trends continue, biofuels are going to escalate human misery and environmental destruction around the world for years to come. Here's why.

Biodiesel

Biofuels have a long history. The first diesel engine was powered by vegetable oil.[1] In the World War II era, more than a million cars in Europe were running on methanol, a fuel that can be made from any kind of cellulose. The auto-makers of the time installed brackets on the frames of cars assuming that people would install methanol converters in their cars.[2] People were running their cars on corn cobs, wood chips, and other woody debris. Anyone who has purchased gasoline in middle America has seen ethanol for sale. The "ethanol" sold at the pump is usually a mix of gasoline and ethanol, the latter made from corn and other grains.[3] In the 1980s, Brazil converted 70 percent of their transportation fleet to ethanol made from sugar cane.[4] Their experience is perhaps most instructive as regards the development of biodiesel.

Brazilian cars in the1980s ran more cleanly with alcohol fuel, and with less dependency on Middle Eastern oil. As a result of the increased demand for sugar cane, big cane producers pushed out smaller farmers, and many acres previously dedicated to growing beans to feed people were converted to sugar cane production to feed the cars of the rich. Given the superior market power of car drivers, sugar cane took precedence, and the price of beans and other staples went up. The poor went hungry, and the rich fed their cars well.[5]

It is important to put biodiesel in the larger ecological context. Anyone familiar with the principles of biological systems knows that ecosystems form a pyramid. At the bottom of that pyramid are the plants who first convert sunlight to bio-energy. Plants make up the largest volume of organic matter in any ecosystem. Just above the plants come insects, small animals, and animals that eat plants. Further up the pyramid are animals that eat animals, and at the top of the pyramid are the large carnivores. Fats in the form of vegetable oil and animal fat are concentrated forms of energy, and are used by plants and animals to store energy.

1 Nitske, W. Robert, Wilson, Charles Morrow, Rudolf Diesel, Pioneer of the Age of Power, University of Oklahoma Press. 1965
2 http://www.woodgas.com
3 http://www.ethanol.org
4 The Brazilian Experiment at http://www.answers.com/topic/alcohol-fuel
5 The Brazilian Experiment at http://www.answers.com/topic/alcohol-fuel

result? Very little change in the growth curve before collapse. Then they created a theoretical infinite energy supply. The result? The life of industrialism was extended by only a decade or two.

How could it be that energy supplies have so little affect on the lifespan of industrialism? Because there are myriad other limits; the supply of other raw materials, the exhaustion of farms and fisheries, the filling of pollution sinks. The ability of the planet to absorb pollution, generate clean water, renew the soil, any of these systems can be overrun only with disastrous consequences. Of all the major mineral resources we use currently, only three (iron, titanium, aluminum) are so plentiful as to be inexhaustible.[1] The rest are being used on an unsustainable basis. If our energy supply were infinite and clean, industrialism would collapse because of a myriad other limits. No energy source can replace all the ecological systems and inorganic resources that support or lifestyle.

If our purpose is to protect the living earth, to provide for the viability of plants, animals, and humans into the future, then we have to recognize that the current biofuels movement is going to accelerate the destruction. Industrialism as it is presently practiced has a voracious appetite for resources. If we supply our industrial and transportation systems with biofuel, that biofuel has to come from somewhere. It will come from already overstressed biological systems. Feeding the industrial machine with any new fuel will only increase the ability of people and machines to move into natural areas, and consume forest, fields, and oceans.

Biodiesel is the most destructive of all biofuels. Hydrogen , no matter how it is produced, will only accelerate ecological decline because it will allow the industrial economy to accelerate its destruction of forests and fields through suburban sprawl and commercial development. Hydrogen supports the myth of infinite growth. President Bush supports hydrogen.[2] Think about it.

We are most often very pleased to entertain any answers except the right ones. If you look at the brightest examples of eco-homes, there is always a detailed explanation of the immediate energy costs, but never is there an analysis of the life-cycle costs of such energy efficient homes. The reason is that if you look at the embedded energy costs of an American model energy efficient home and extrapolate that across the lifetime of its inhabitants, the final analysis does not approach anything any reasonable person could call sustainable because the house is large and used by only one or two people.

1 Meadows, 1992, ibid, p. 84
2 http://www.whitehouse.gov/news/releases/2003/01/20030128-19.html

lush green forests into moonscape and chips.[1] The chips are then burned instead of coal to generate steam that turns the electric turbines, thus keeping the lights, computers, air conditioners and tumble driers of America in operation. Careful what you wish for. If you try to meet America's energy demands from the supply side, you are simply going to throw unsustainable weight onto already overstressed biological systems.

If you try to get your energy from any "alternative" source, the same supply-side principle applies. If you tried supply the average American household with solar electric (photovoltaic) panels, it would cost tens of thousands of dollars.[2] Not only is that financially unfeasible, that money also represents a huge environmental price in the energy embedded in the manufacturer of those solar panels. The life-cycle payback (ratio of energy generated to the cost of the system for the life of the system) of such an approach is very high, well beyond any reasonable margin of "sustainability." The only feasible way to supply a household with alternative energy is to first dramatically reduce the energy consumption of that household.

Neither can we deal with transportation fuel by attacking the problem from the supply side. The environmental costs of automobiles is huge regardless of how they are fueled. Few people realize that the average car has 25% as much energy embedded in its production as it will burn in it lifetime.[3] As soon as you buy a car, you have already used thousands of gallons of fossil fuel before you turn the key. Neither high-efficiency cars nor biofuels affect that fact.

Hydrogen, Solar, and Other Fuels

The essence of an ecological perspective is looking at whole systems. Some years ago, Donella Meadows and the Club of Rome looked at our energy supply as part of a world economic and ecological systems. (See *The Limits to Growth* and *Beyond the Limits*.)[4] They pointed out that geometric growth (the current rate of industrial expansion) within a closed system (Earth) ultimately leads to collapse. They also made some far more interesting discoveries. They asked the question, what if we dramatically increased our theoretical energy supply? They manipulated the variables in their computerized world models to reflect this assumption. The

1 http://www.eia.doe.gov/oiaf/analysispaper/biomass

2 Photovoltaic electricity costs a minimum of $4.00 per watt for the panels alone, often closer to $10.00 per watt for a fully installed system. That means an installed cost approaching $1,000 to simply light a 100 watt light bulb. Hence the savings of installing a smaller or more efficient bulb instead of trying to meet existing demand.

3 http://www.ilea.org/lcas/macleanlave1998.html

4 Meadows, Donella, The limist to Growth, A Report for the Club of Rome's Project on the Predicament of Mankind, 1974, Meadows, Donella, Beyond The Limits, Confronting Global Collapse, Envisioning a Sustainable Future, Chelsea Green Publishing Co., Post Hills, VT 1992

This pyramid is relevant to biofuels because different biofuels tap the pyramid at different points. Methanol can be produced from any form of cellulose, and thus uses feedstock from the very bottom of the pyramid. Ethanol can be made from any kind of starch or sugar, and thus takes its feedstock from the middle of the pyramid. Biodiesel takes as its feedstock vegetable oil, which is further up the pyramid.[1] Feeding vegetable oil to cars represents a similar ecological equation to feeding bacon double cheeseburgers to humans.

If biodiesel is more ecologically expensive, then why is it becoming so popular? Because factors other than ecology are driving the biodiesel revolution. Environmental laws such as they exist in this country have been easier to enact when the impacts fall closer to home. Thus global warming is exceedingly difficult to influence through legislation because its victims are distant in time and space. The strongest environmental regulations in the country concern urban air quality.[2] Not coincidentally, a lot of Americans live in cities which are very much affected by air pollution. Biodiesel burns cleaner than fossil fuel, as does ethanol. As a result, some cities are converting their bus fleets to biodiesel to help clean up urban air.[3] Methanol, like gasoline, is toxic. Even though its feedstock is cheaper and more available, it has fallen out of favor because it puts people in its immediate vicinity at risk. Biodiesel will harm thousands of people, but like the casualties of global warming, these people are sufficiently removed in time and space that they remain voiceless.

Another factor favoring the development of biodiesel is the ease with which it is converted to automotive fuel. Methanol and ethanol are both somewhat complicated to manufacturer. Under some circumstances, vegetable oil can be used as fuel with no conversion at all. Even when biodiesel is modified, the conversion is a relatively simple process. This has made it a favorite of urban environmentalists and rural homesteaders alike. This in combination with the clean burn has brought biodiesel to the forefront of biofuels.

Anther great charm of biodiesel is the fact that it is made from discarded cooking oil. But is that oil really waste? Why is it sitting there behind that restaurant anyway? That barrel of oil is there because it was put there by a oil reclamation company. Used vegetable oil is reprocessed into a wide variety of products. Being a long-chain hydrocarbon, vegetable oil, like its fossil cousin, is a highly flexible commodity that can be used to produce an enormous variety of products.

In my hometown, the barrels behind fast food restaurants have "Valley Proteins" written on them. That turns out to be one of the four largest rendering and

1 http://www.physicalgeography.net/fundamentals/9o.html

2 Martineau, Robert J., Novello , David P., The Clean Air Act Handbook , Chicago, Ill., American Bar Association, 2004

3 http://www.thesoydailyclub.com/BiodieselBiobased/biodieselbuses12092003.asp

used cooking oil collectors in the country, currently serving 17 states. They reprocess dead animals, inedible animal remains from slaughterhouses, and used cooking oil into a wide variety of products. From a report from American Capital (who recently invested $10 million in Valley Proteins) we learn that "Valley Proteins turns the raw materials it collects into commodity goods which are sold to over 170 customers that include producers of livestock feed ("feed mills"), pet food and refiners of fatty chemicals. The company's finished products are quoted on established commodity markets or priced relative to substitute commodities. The primary finished goods include fat and protein products, which are used in hundreds of commercial applications. Fat products are sold predominately to commercial animal feed manufacturers and to manufacturers of pet foods, fatty acids, chemicals and lubricants. The products are also used as an ingredient in bio-diesel (a blend of petroleum fuel and methyl esters derived from animal fats or vegetable oils), a cleaner burning substitute for diesel fuel. The company in fact has modified its own boiler equipment to use the lower priced fats it produces in its rendering plants and thereby minimize boiler fuel expense."[1] About 80% of the reprocessed fats from rendering companies are used in livestock feed. The rest is used by "splitters," companies that process oils into fatty acids and glycerine, as well as other companies that produce industrial lubricants, as well as cosmetics and soap.[2]

The key phrase in the previous paragraph is "products are quoted on established commodity markets or priced relative to substitute commodities." Used cooking oil is not a waste or discarded product. It is reprocessed and put on the market to vie with substitute commodities. Any of the many companies using products from Valley Proteins is likely to simply purchase the cheapest adequate product regardless of its source. If the companies and consumers should run short of products that were originally made with used vegetable oil, they simply turn to products made from virgin oil.

If biodiesel consumption remained within the supply of used vegetable oil, that would all be fine. But the consumption of fossil diesel radically exceeds the supply of used oil. If Americans are convinced that biodiesel is a "green" fuel, and we drive up the consumption of vegetable oil, we simply shift the weight of demand onto the virgin vegetable oil market. Americans use nearly a billion gallons of petroleum a day.[3] The entire output of all of the rendering/ used cooking oil collection companies in the U.S. is about a billion and a half gallons *per year*.[4] If all of the used oil presently used for all other purposes were diverted into the fossil fuel market, it would last us a day and half. If you look solely at the consumption of

1 http://www.americancapital.com/news/press_releases/pr/pr.cfm?p_prpr20040624a.html
2 Personal Commuication with Valley Proteins, See also Render Magazine
3 http://www.eia.doe.gov/emeu/cabs/usa.html http://www.nationmaster.com/country/us/Energy
4 Personal Commuication with Valley Proteins, See also Render Magazine

crop production is being used to feed animals: the number of livestock on earth has quintupled since 1950. The reason is that those who buy meat and dairy products have more purchasing power than those who buy only subsistence crops.

Green fuel is not just a humanitarian disaster; it is also an environmental disaster. Those who worry about the scale and intensity of today's agriculture should consider what farming will look like when it is run by the oil industry. Moreover, if we try to develop a market for rapeseed biodiesel in Europe, it will immediately develop into a market for palm oil and soya oil. Oilpalm can produce four times as much biodiesel per hectare as rape, and it is grown in places where labour is cheap. Planting it is already one of the world's major causes of tropical forest destruction. Soya has a lower oil yield than rape, but the oil is a by-product of the manufacture of animal feed. A new market for it will stimulate an industry that has already destroyed most of Brazil's cerrado (one of the world's most biodiverse environments) and much of its rainforest...

At a meeting in Paris last month, a group of scientists and greens studying abrupt climate change decided that Tony Blair's two big ideas - tackling global warming and helping Africa - could both be met by turning Africa into a biofuel production zone. This strategy, according to its convenor, "provides a sustainable development path for the many African countries that can produce biofuels cheaply". I know the definition of sustainable development has been changing, but I wasn't aware that it now encompasses mass starvation and the eradication of tropical forests. Last year, the British parliamentary committee on environment, food and rural affairs, which is supposed to specialise in joined-up thinking, examined every possible consequence of biofuel production - from rural incomes to skylark numbers - except the impact on food supply.

We need a solution to the global warming caused by cars, but this isn't it. If the production of biofuels is big enough to affect climate change, it will be big enough to cause global starvation.

Supply Side Versus Demand Side

All of this begs the question, if not biodiesel,then what? We have to have some source of energy, for transportation and otherwise. The issue is whether you work on the problem from the demand side or the supply side.

If you take any modern energy system and try to address it from the supply side, you will invariably fail. Already, there is a movement to use biofuel to generate the nation's electricity. What does that mean? That means massive tree chipping operations have started descending on our national forest, thus converting

to be used. When he demonstrated his engine at the World Exhibition in 1900, he ran it on peanut oil. "The use of vegetable oils for engine fuels may seem insignificant today," he predicted. "But such oils may become in course of time as important as petroleum." Some enthusiasts are predicting that if fossil fuel prices continue to rise, he will soon be proved right.

I hope not. Those who have been promoting these fuels are well-intentioned, but wrong. They are wrong because the world is finite. If biofuels take off, they will cause a global humanitarian disaster.

Used as they are today, on a very small scale, they do no harm. A few thousand greens in the United Kingdom are running their cars on used chip fat. But recycled cooking oils could supply only 100,000 tonnes of diesel a year in this country, equivalent to one 380th of our road transport fuel.

It might also be possible to turn crop wastes such as wheat stubble into alcohol for use in cars - the Observer ran an article about this on Sunday. I'd like to see the figures, but I find it hard to believe that we will be able to extract more energy than we use in transporting and processing straw. But the EU's plans, like those of all the enthusiasts for biolocomotion, depend on growing crops specifically for fuel. As soon as you examine the implications, you discover that the cure is as bad as the disease.

Road transport in the UK consumes 37.6m tonnes of petroleum products a year. The most productive oil crop that can be grown in this country is rape [canola]. The average yield is 3-3.5 tonnes per hectare. One tonne of rape seed produces 415kg of biodiesel. So every hectare of arable land could provide 1.45 tonnes of transport fuel.

To run our cars and buses and lorries on biodiesel, in other words, would require 25.9m hectares. There are 5.7m in the UK. Even the EU's more modest target of 20% by 2020 would consume almost all our cropland.

If the same thing is to happen all over Europe, the impact on global food supply will be catastrophic: big enough to tip the global balance from net surplus to net deficit. If, as some environmentalists demand, it is to happen worldwide, then most of the arable surface of the planet will be deployed to produce food for cars, not people.

This prospect sounds, at first, ridiculous. Surely if there were unmet demand for food, the market would ensure that crops were used to feed people rather than vehicles? There is no basis for this assumption. The market responds to money, not need. People who own cars have more money than people at risk of starvation. In a contest between their demand for fuel and poor people's demand for food, the car-owners win every time. Something very much like this is happening already. Though 800 million people are permanently malnourished, the global increase in

diesel, the entire output of used vegetable oil in the US represents about 3% of how much diesel we use.[1] And that simply begs the question of where industry would turn to for all that cattle feed.

Is biodiesel renewable? Any resource is renewable only if it is extracted at a rate no greater than it is replenished. Overcutting a forest or overfishing a fishery renders a renewable resource non-renewable. Given that biodiesel potentially involves taking human food from high in the ecological pyramid and feeding to automobiles, the renewability issue is paramount.

If we are going to feed human food to cars, we need to know how much surplus food production capacity we have. We get our food from a number of sources. Do you know when the world fish catch peaked? In the early 1980s.[2] What about grain production? Per capita production peaked in 1980s.[3] Irrigated farmland produces a lion's share of human food. How is the supply of irrigated land holding up? Because of salinization, erosion, and other management issues, the global supply of irrigated farm land per capita has shrunk precipitously in the last several decades.[4] The final humbling fact is that, even though the U.S. has the most productive agricultural system in the world, we are now a nation that teeters on the brink of agricultural debtorship. Beginning in the 1990s, we have imported more food than we have exported in some years.[5] The staggering fact is that all of these biological limits were being reached before the advent of the Adkins fad in U.S.,which is driving our consumption of ecologically expensive foods skyward.[6] Our current circumstance also predates the broader impact of biofuel conversion. In 2004, global grain stocks reached their lowest point in nearly 30 years.[7] The point is not that the global agricultural system is on the verge of collapse. It isn't. But it is a finite resource that is already heavily taxed.

If the amount of irrigated farmland per person has actually shrunk, how is it that we continue to feed growing populations? The phrase "the oilification of food" was first coined a few decades ago, but it is more relevant than ever. The amount of energy we invest in each calorie of food produced has climbed steadily, and continues to climb. We have been replacing soil with oil. We now invest many calories of fossil fuel for each calorie of food we get in return. That is long before

1 http://www.eia.doe.gov/cneaf/alternate/page/datatables/table10.htm
2 Brown, Lester, State of the World 1993, Norton, NY, 1993, p.12
3 Brown, ibid., p.13
4 Gardner, Gary, Shrinking Fields, Cropland Loss in a World of Eight Billion, WorldWatch Paper 131, WorldWatch Insitute, 1996, p. 20

5 Stang, Patti, Conley, Stephen, USA Snapshots, Food Exports Are Cooking, USA Today, July 27, 1994
6 http://www.grist.org/comments/soapbox/2004/02/09/you/
7 http://www.heifer.org/Learn/World_Ark_Online/Lester_Brown.shtml

anyone considers putting those food calories into a gas tank.[1] (If you check the footnotes of any energy-food calculations, you will eventually find yourself reading the words of David Pimentel. Although he is not famous, he is the individual who essentially created the field of energy/ food conversion research. He has been trying to sound an alarm for a long time about the oilification of food.)

There are grossly conflicting claims regarding how much fossil fuel is required to produce a gallon of biodiesel. Some biodiesel advocates say that one gallon of fossil fuel used on the farm produces several gallons of biodiesel. If that were true, biodiesel would already be dirt cheap and a dominant fuel. Oil company conspiracies aside, neither Archer Daniels Midland nor the American farmer would let that one slip by. Even now, ethanol critics claim that ethanol represents a net energy loss from farm to gas tank, and that ethanol/ gas blends are simply a complicated farm subsidy.[2]

If biodiesel is ecologically expensive, then won't the market correct the problem by keeping biodiesel financially expensive? Maybe, but biodiesel also makes people feel better about driving. This guilt relief adds to its market value, which increases its market power even further relative to third world stomachs. Trends are powerful. The outdoor craze of the 1970s helped spur the SUV craze of the 1990s. Once a movement is started, even should that movement divert grossly from its original intended course, the movement may well continue the way of a merry juggernaut. The guilt-relieving power of biodiesel is enormous. Our society is organized in every respect around the automobile. That fact is terribly difficult to escape regardless of personal intent. In the fall of 2004, the U.S. Congress passed a tax relief bill to promote the use of biodiesel.[3] The European Union is pursuing a similar strategy. National celebrities are promoting its use in the corporate media.[4] The horse is out of the gate.

Americans have a buying power in the global marketplace that grossly outstrips the vast majority of humanity. The slightest whim of purchasing fashion in our economy can send waves through the lives of thousands of people very far away. Already, American pets have more buying power than many third world people. As the fish of the world's oceans have been increasingly swept up in the nets of globe-roaming trawlers, the fish content of American pet food has increased while the fish consumption of poorer peoples all over the world has declined.[5] All over Latin America, beef production has increased, domestic consumption has

1 Pimentel, David, Food, Energy, And Society, University Press of Colorado, 1996
2 http://www.news.cornell.edu/releases/Aug01/corn-basedethanol.hrs.html, see also energyjustice.net and www.energyjustice.net/ethanol/pimentel2001.pdf
3 http://www.biodiesel.org/news/taxincentive/
4 http://www.msnbc.msn.com/id/6826994/ see also http://wired.com/news/technology/0,1282,66288,00.html
5 http://www.unu.edu/unpress/food/8F044e/8F044E05.htm

decreased as more and more beef is shipped to the McNorth.[1] If Americans are willing to eat themselves into obesity, consuming grossly unhealthy amounts of animals foods, why would we imagine that they would be any more restrained in starving people around the world to feed their cars?

Any widespread purchasing decision in the West can have enormous impacts around the world. In my home state of Virginia, the Soybean Association has been offering a rebate for first time volume purchases of biodiesel of up to $500.[2] The only motivation for such action is to bolster the price of virgin oil. This isn't about used fryer oil any longer.

Biodiesel is a powerful movement that is rapidly gaining force. Regardless of intent, if the biodiesel movement succeeds in convincing millions of Americans that biofuel is an ecological solution, they will create a market. The feedstock for that market is the global supply of vegetable oil. That market already shifts spontaneously between reprocessed used oil and virgin stock. Increased consumption of biodiesel beyond the supply of used oil will simply put more demand on virgin stock. As cars with their savage buying power are put into market competition with the hundreds of millions of humans already trying to live on a dollar a day, the latter will lose that tug of war. The global poor, for whom vegetable oil is already a luxury, will do without. Deficiencies of fat-soluble vitamins will escalate.[3] It is no exaggeration to say that biodiesel, if widely adopted in the west, will result in the deaths of many thousands of people around the world.

Biodiesel in Europe

In November 2004, George Monbiot printed an article in the Guardian U.K. about biodiesel in Europe.[4] Here's what he had to say:

Next month, the British government will have to set a target for the amount of transport fuel that will come from crops. The European Union wants 2% of the oil we use to be biodiesel by the end of next year, rising to 6% by 2010 and 20% by 2020. To try to meet these targets, the government has reduced the tax on biofuels by 20p a litre, while the EU is paying farmers an extra €45 a hectare to grow them.

Everyone seems happy about this. The farmers and the chemicals industry can develop new markets, the government can meet its commitments to cut carbon emissions, and environmentalists can celebrate the fact that plant fuels reduce local pollution as well as global warming. Unlike hydrogen fuel cells, biofuels can be deployed straightaway. This, in fact, was how Rudolf Diesel expected his invention

1 http://www.wrm.org.uy/bulletin/85/LA.html#Brazil
2 http://www.deq.state.va.us/p2/vise/biodiesel.html
3 Personal Communication, Esther Burns, Dietician
4 http://www.guardian.co.uk/renewable/Story/0,2763,1357463,00.html